A Web-based Database for the Mine Burial Program And Site Surveys of the Mine Burial/Coastal Processes Experiment Site at the WHOI Coastal Observatory, Martha's Vineyard

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LONG-TERM GOALS

The long-term goal of the Mine Burial Program is to develop a better understanding of the coastal processes driving mine burial in shallow water coastal environments.

SCIENTIFIC OBJECTIVES

The scientific objectives of the Mine Burial Program are to develop specific models for mine burial driven by coastal processes, to carry out both laboratory and field programs designed to test these models, and to develop probability statements with respect to the likelihood of mine burial. Two field areas have been identified for this project, one off St. Petersburg, Florida and the second off Martha's Vineyard, Mass. The University of New Hampshire is providing support for these objectives through two separate efforts: 1- the development of a web-based database for the Mine Burial Program and; 2- the collection, processing and analysis of high-resolution multibeam sonar data at the Martha's Vineyard field area. In conjunction with investigators from the University of Texas (John Goff), the University of Hawaii (Roy Wilkins), the USGS (Bill Schwab), and Woods Hole Oceanographic Institution (Peter Traykovski), we will use both the sonar data and the database to investigate the statistical properties of sedimentological and morphological variability, as well as track changes in bedform morphology and other time dependent seabed processes.

APPROACH

Detailed seafloor mapping and characterization will be critical to the success of both the experimental and theoretical components to the mine burial program. While the sedimentary properties of any survey area must be described before we can understand mine burial processes, we must also understand the variability and areal distribution of sediments in the target location – necessary to understand the natural variability of the burial process. We cannot rely on a few samples in the target area, but rather we need to map and characterize the area as completely, and with as much detail, as possible. Furthermore, we also cannot rely on a single map. We expect the seafloor to change over time – from season to season, and as bedforms migrate along the seafloor (one of the important burial mechanisms). We need the capability to map both the morphology and sedimentary properties of the target area as frequently and inexpensively as possible.

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Our approach is to use multibeam sonar mapping to monitor the seafloor and its changes. Multibeam mapping is quick, relatively inexpensive, and maps can be generated in near real time. The detailed bathymetry provided by the latest technology is unparalleled and in addition, many the systems can produce georeferenced backscatter maps that may provide critical insight into the distribution of seafloor properties.

Another component of our effort is the "ground-truthing" of sidescan and multibeam backscatter data against the measured sedimentological and geotechnical properties of the seafloor. Other investigators are collecting sediment samples for physical and geotechnical properties (Goff), subbottom profiles (Wilkens) and super-high resolution pole mounted sector scanning sonar records (Traykovski). In support of these efforts, we have deployed our *in-situ* sound speed and attenuation probe (ISSAP – see GEOCLUTTER report) to make *in-situ* measurements of the near-surface sediment properties.

To conduct the detailed high-resolution multibeam surveys we have chosen a Reson 8125 multibeam sonar. With its dynamic focusing and 0.5 degree beamwidths, the 8125 has demonstrated the ability to achieve higher resolution and faster ping rates than any other multibeam sonar presently available. Very precise positioning is also critical to achieve the highest resolution possible and to enable meaningful repeat surveys. Thus we have also established an array of kinematic DGPS positioning receivers on Martha's Vineyard and have had diver-deployed sonar reflectors emplaced in the survey are to act as fiducials for repeat surveys. Finally we have established and are maintaining the Mine Burial Web Site to act as a central repository for Mine Burial experiment data as well as a focal point for information exchange and analysis.

WORK COMPLETED

The mine burial experiment will take place in water depths ~8-18 m, within a relatively confined area focused around an existing coastal observatory node – the Martha's Vineyard Coastal Observatory (MVCO). The MVCO is located in 12 m of water and provides both power and hard-wired data telemetry back to shore.

In February 2001, the USGS, in conjunction with Peter Traykovski, collected DF1000 sidescan sonar and boomer data in a small (2 x 3.5 km) area centered around the MVCO site. Seven months later, the USGS conducted a regional bathymetric and sidescan sonar survey using a 134 kHz Submetrix interferometric sonar. These surveys provided a baseline within which to plan our detailed multibeam sonar survey. They also provide a baseline from which to understand regional sediment movements.

Between July 13th and 17th we conducted the Reson 8125 multibeam survey aboard the SAIC vessel *Ocean Explorer*. The survey consisted of a super high-resolution (4 m overlap) survey in a small area surrounding the MVCO node and mine burial sites, a slightly lower resolution survey (12 – 25 m overlap) in a box approximately 1 x 1 km surrounding the "target box" and a lower resolution survey (25 – 40 m line overlap) in a 3 x 5 km region surrounding the 1 x 1 km box. The vessel, the operators, and the Reson 8125 performed flawlessly through a range of sea states. We completed all of the work scheduled at precisely the coverage levels planned.

In order to obtain the resolution needed for repeat surveys and understand changes in the seafloor at levels of 10 cm or better, we established 3 kinematic GPS base stations on Martha's Vineyard and 3 kinematic GPS receivers on the survey vessel. These systems appeared to have worked well throughout the survey period though the final analyses of the kinematic GPS data will take several months.

Between 4 and 6 August the UNH team also participated in a cruise aboard the *R/V Cape Henlopen*. This cruise was designed to collect core samples and *in-situ* measurements that will help us better understand the nature of the seafloor geology as well as better interpret the sidescan sonar and backscatter data already collected. On this cruise the UNH team deployed the *I*n situ *S*ound *S*peed and *A*ttenuation *P*robe (ISSAP –see GEOCLUTTER annual report for a description) making numerous measurements of *in situ* sound speed and attenuation in the mine burial area. In addition a newly constructed resistivity probe was deployed on ISSAP adding *in situ* determinations of porosity to the suite of measurements made.

RESULTS

The Reson 8125 produced approximately 1 Gigabyte of data per hour, and the SAIC and UNH teams worked hard to do preliminary processing as quickly as possible. To date all data has undergone preliminary processing. A gridded data set representing the bathymetry of the target area and the medium resolution survey has been generated and made available to other Mine Burial researchers. The bathymetric resolution we were able to achieve was beyond our expectations. The node site and all diver-emplaced reflectors were clearly identified (Figure 1). Most amazingly, we are able to resolve fields of individual ripples that are less than 2 cm in height (Figure 2).

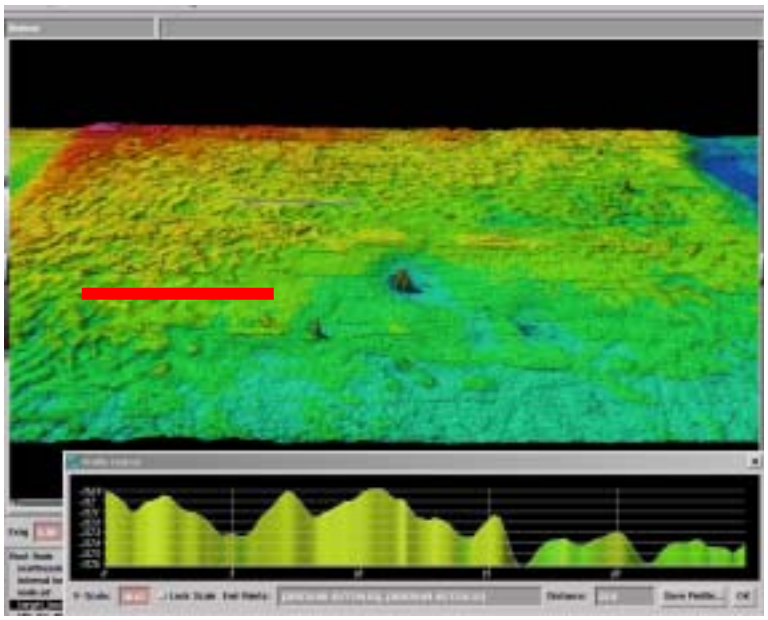

Figure 1. 3-D view of preliminary gridded bathymetry from central region of Martha's Vineyard mine burial site. Large target in center of figure is the MVCO node base. Targets below and to left (southwest) and above and to right (northeast)of node site are reflectors placed by divers to act as fiducials for repeat surveys – both are less than 1 m above the seafloor. Profile at bottom of figure is area under red line in upper figure. Height of features in area is 3 – 6 cm.

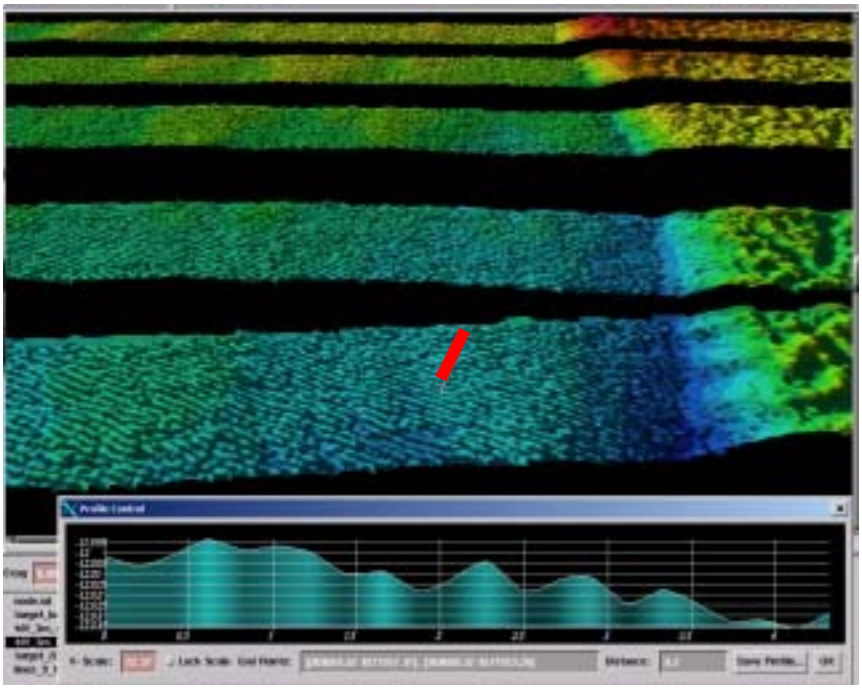

Figure 2. Reson 8125 bathymetry from rippled scour depression at Martha' Vineyard mine burial site. System can clearly resolve individual ripples. Profile at bottom of figure represents area under red line in upper figure. Ripple heights are between 1.5 and 2 cm!

Of particular relevance to the mine burial program was our ability to resolve an instrumented mine that had been deployed earlier by NRL (Figure 3). This mine is buried in a scour depression and is only a few centimeters proud above the base of the depression.

Results from the deployment of the ISSAP were equally successful. During the three-day August cruise, 87 acoustic (sound speed and attenuation) and resistivity (porosity) stations were occupied representing more than 50,000 discrete measurements and more than 30 Gigabytes of data. At nine stations we were able to make measurements at two different frequencies (100 and 65 kHz) and at about half the stations continuous measurements were made as the probes entered the interface. Data quality is very high and analyses area currently underway.

Finally, a preliminary version of the Mine Burial Website is up and available to the community at http://www.mbp.unh.edu. This site contains background information on the program, participant and meeting lists as well as much of the data that has already been collected (Fig 4). A prototype of a more sophisticated version of the site has been set up and is currently undergoing final tests.

IMPACT/APPLICATIONS

The multibeam survey has provided the morphological and sedimentological context for all investigators as well as demonstrated the ability to directly detect very small features on the seafloor. Most importantly, the multibeam data will provide us with an understanding of the distribution of very small-scale bedforms and topography (like the scour-pit) at a scale unobtainable by other means. This, in turen, will hopefully be of tremendous value to the modelers. With ground-truthing studies we hope to gain insight into the mechanisms of sediment transport and the potential for using backscatter to

better understand seafloor property changes at the test site. The database will become the central repository for all project related work as well as providing the project team and others the tools necessary for efficient data exploration.

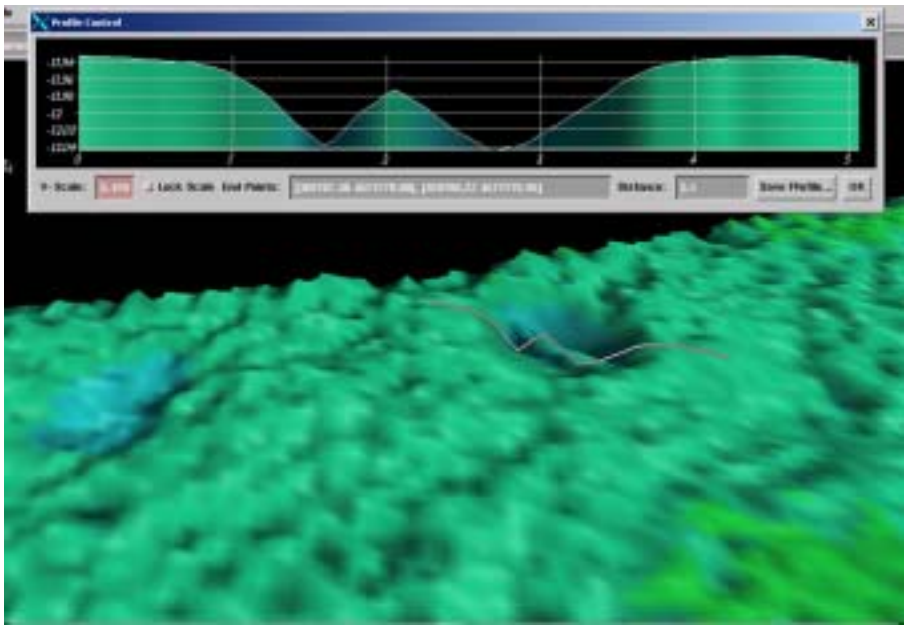

Fig 3. 3-D image of NRL mine in scour pit at MVCO site. Profile above is cross-section over mine and across scour pit. Mine is sitting 5-6 cm proud above bottom of 10 – 12 cm deep scour pit.

Fig. 4 Field program page from preliminary Mine Burial Website

TRANSITIONS

None yet.

RELATED PROJECTS

GEOCLUTTER, Uncertainty DRI